Brave New World War[1]

Jamie Metzl[2]

HEINRICH BÖLL STIFTUNG NORTH AMERICA

Whether it arrives a decade from now or more, the day will come when the human race, or at least a subset of us, will have the ability to take control of key aspects of our own evolution. But while national and global debates on such issues as in-vitro fertilization (IVF), stem cell research[3], and genetically modified organisms (GMOs) have begun to open people's mind to the challenges and opportunities of revolutionary advances in the life sciences, the world remain dangerously unprepared for the international genetic "arms race" that could one day emerge. To maximize the benefits of these new capabilities while minimizing the potential harms, and to keep popular fears of this enormous transformation from overcoming its potential contribution to the quality and security of human life, the world community must develop new standards for human genetic manipulation and an enforcement structure capable of preventing the most dangerous abuses.

The convergence of complementary and mutually reinforcing advances across the fields of nanoscience, biotechnology, information technology, human fertility, gene therapy, molecular biology, and cognitive science makes the arrival of more revolutionary capabilities in human reproductive, or "germline", engineering inevitable. Our species will in the near future become equipped with the Promethean ability to manage our own evolutionary process to an extent and at speeds that Charles Darwin never could have imagined. As opposed to the somatic gene therapies[4] already in use today which target non-reproductive cells, germline technology alters reproductive cells at the outset of the fertilization process, allowing genetic changes to be replicated in every ensuing cell.

Although germline engineering is not being carried out on humans today, the process is already being used widely in experiments with laboratory animals such as mice. Scientists disagree over the timeframe, but most generally accept that this technology will soon reach a stage of development where it could be used on humans. Already today, the pre-implantation Genetic diagnosis (PGD) process enables parents to choose the healthiest of their fertilized eggs, or select a gender, prior to re-implantation in the In Vitro Fertilization (IVF) process. In the future, a relatively simple additional step will allow an artificial chromosome with a targeted genetic manipulation to be inserted into such a fertilized egg. As these capabilities advance, they will hold the key to potentially massive enhancements to human life and well-being.

Just as advances in agriculture, sanitation, and health care have enhanced the length and quality of our lives (and transformed whatever an alternate evolutionary process might have been), so too will advances in bioengineering help secure and enhance our future – extending our lives, making us immune to diseases, massively expanding our memory capabilities, and expanding

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1 Reference to Aldous Huxley`s „Brave New World", 1932; which is the archetypal and still instructive 20th century biopolitical scenario.

2 The author is an expert on Southeast Asian history and politics, Executive Vice President of Asia Society, United States.

3 Stem cells are cells capable of developing into a variety of specialized cells and tissues. Stem cells may have therapeuthic value, but could also be used for non-medical „enhancement" procedure.

4 Somatic Gene therapy is provided by introducing a new therapeutic gene (transgene) into the diseased cells of a patient. The modified cells express the introduced gene and their new phenotype provides some advantage to the patient.

our sense perceptions, to only name a few possibilities.

But as these scientific capabilities spread quickly around the world, legitimate and imagined fears will emerge of an unlimited phantasmagoria of real and perceived dangers including the loss of genetic diversity, the creation of Frankenpeople, and the unknown outcomes of meddling with a system as infinitely complex as the human being.

Although spectacular debates have emerged within societies and in international fora on many issues related to the human genetic manipulation process, and although some states will certainly mandate tough restrictions on these capabilities, it will be extremely difficult to stop motivated states or groups of individuals from engaging in human genetic manipulations that go beyond any commonly accepted norms. On the contrary, some will have an increasing incentive to move forward aggressively.

In today's increasingly globalized economy, individuals, corporations, and states tirelessly seek even the smallest advantages over competitors that can then be leveraged into industry-transforming gains. It is extremely difficult to believe that these types of competitive pressures will not also become drivers of the human genetic manipulation process. On the contrary, it is far more likely that humans, or at least some groups of us, will seek to provide our children with the competitive advantages that would come with exceptional capabilities.

As the embrace of these capabilities grows, new fissures will emerge both within societies and between them.

Within societies, social Darwinists have long claimed that the elites were smarter and had a greater natural capacity than the masses, a concept that has clearly been proven wrong as opportunity has democratized. But, what if in addition to having better nutrition, more exposure to ideas, and better schooling, the rich and privileged within a society also had genetic manipulations that actually made their brains function better? Would it begin to make sense for these enhanced people to assume leading roles in running institutions and governments and making decisions on behalf of the less enhanced populace? Uneven genetic enhancement could place enormous strains on the democratic process.

Between societies, two types of strains might emerge. First, enormous conflict would likely ensue between the states that ban or restrict new forms of human genetic manipulation and those that do not. If the current debate over genetically modified crops is anything to go by – where many Europeans see an existential threat to their way of life and Americans and Asians are generally far less concerned – the stress on international systems over genetically modified people would be monumental.

But if one country with different norms for example, were to move forward with an aggressive genetic enhancement program while other countries ban or limit these activities, competitive pressures would force the other countries to choose between accepting a deteriorating relative position in the world, working to halt the genetic enhancement activities going on in the outlyer country, beginning such genetic enhancement activities themselves in order to keep up, or seeking international consensus on what an acceptable governance framework might look like.

Second, the existing divide between rich and poor countries would become even greater. If access to adequate food, health care, governance, and education make it seem like those living in developed and underdeveloped countries live in different worlds, uneven access to the coming capabilities for human genetic manipulation will make it seem that rich and poor countries inhabit different universes.

The challenge for the world, therefore, will be to maximize the benefits of the inevitable scientific progress, while seeking to develop globally accepted norms and standards for human genetic research and its applications that can prevent the worst abuses and establish an international framework for addressing and mitigating the conflicts that will emerge.

Some efforts, although insufficient, have already been made, including the 1997, UNESCO *Declaration on the Human Genome and Human Rights*, which prohibits "practices which are contrary to human dignity, such as reproductive cloning of human beings." In 1998 the Council of Europe agreed to the *Convention on Human Rights and Dignity with Regard to Biomedicine*, which asserted that interventions aimed at modifying the human genome can only be undertaken "for preventive, diagnostic or therapeutic purposes and only if its aim is not to introduce any modification in the genome of any descendents."

The February 2002, the United Nations Ad Hoc Committee for an International Convention Banning Human Reproductive Cloning began negotiations intended to lead to a binding treaty. The non-binding General Assembly resolution *United Nations Declaration on Human Cloning*, adopted in March 2005 by a vote of 84 in favor, 34 against and 37 absentions, called on member to "prohibit all forms of human cloning inasmuch as they are incompatible with human dignity and the protection of human life."

The weakness of all of these documents and the standards they seek to set is obvious based on the lack of both consensus and enforcement power. As in the UN resolution, the countries with the most to gain from and the greatest hopes for this scientific advancement are and will remain extremely reluctant to have their activities limited by others. Even if a consensus were to emerge, enforcement power is, with the partial exception of Europe, focused on the national level, while the knowledge and capabilities for engaging in this activity is increasingly mobile and able to find a home wherever standards are more lax. These documents also say very little about establishing standards for how even research that fits in principle into accepted norms should be carried out.

Some genetic manipulation, for example, might be considered acceptable if chromosomes are inscribed with genetic instructions making it impossible for introduced mutations to be transferred to future generations, or if artificial chromosomes contain chemical "switches" that can be used to activate or de-activate specific genes. Although the expertise currently exists to make a germline genetic mutation non-inheritable, the world community would still have to figure out a way of ensuring that any human genetic manipulations are carried out in a matter which does this. The issue in this case is not whether a mutation is introduced, but how it is introduced.

Any international regime would therefore have the tough dual role of being both an enabler of responsible, sound technological advancement and an enforcer of limitations as to how far these activities can go.

There are few successful models in the international legal system for doing this effectively, but in spite of its flaws and limitations, the Nuclear Non-Proliferation Treaty (NPT) may be the least bad model among them.

The 1970 NPT sought to limit the spread of nuclear weapons by establishing both standards for non-proliferation of the five states permitted to own nuclear weapons (Britain, China, France, USA, and the USSR) as well as a set of incentives designed to encourage non-nuclear armed states to remain so. The non-nuclear signatories of the NPT basically agreed to refrain from

acquiring or developing nuclear weapons in exchange for a promise from the five nuclear-armed states to help the others develop nuclear energy capacities for peaceful purposes.

Although the NPT has come under increasing strain[5] the treaty still boasts an overall impressive track record. Signatory states South Africa and Ukraine voluntarily gave up their nuclear weapons, Libya publicly renounced its secret effort to develop them, and the acquiring of nuclear weapons by non-nuclear states remains a taboo, even if a weakening one.

The potential for a genetic "arms race" and the potential for a nuclear arms race share certain characteristics. Both deal with the implications of cutting edge technologies whose applications become increasingly accessible to wider groups of people and states, both represent capabilities that have enormous potential to improve people's lives matched by a similarly great potential to harm them. And both represent technological capabilities developed in more advanced countries that become desirable the world over.

An NPT-like framework for human genetic engineering would be incredibly difficult to negotiate because it would need to neither offend the sensibilities of powerful constituencies deeply uncomfortable with the concept of human germline engineering nor impede the beneficial development of new generations of knowledge and its application. In addition the standard would need to be extremely permissive, and flexible enough to keep the more scientifically aggressive countries on board. Although this balance would be enormously difficult to develop, finding it will be critical to preventing an unimpeded, unregulated human genetic "arms race".

According to a Human Genetic Modification Abuses Non-Proliferation Treaty, states possessing greater knowledge in the field of genetics would pledge to share basic science capabilities and the broadly-defined benefits of this science with those states that agreed to accepted protocols for human genetic manipulation and to implement appropriate regulations, presumably requiring the non-inheritability of germline genetic manipulations and the banning of human reproductive cloning. At regular intervals, the basic tenets of the treaty, including the list of what is considered to be an abuse of the genetic modification process, will need to be re-negotiated. Those states that allowed violations of the treaty on their territory would be required to immediately stop the violating activity or face sanctions

Two serious objections to this approach demonstrate the imperfections of such a treaty, but do not suggest a better course. The first is that states will need to develop their own standards for genetic modification before they can consider an international regime. Although this argument makes some logical sense, the danger is that the science is moving so quickly that the international community must work to establish an enforceable, if changeable, international standard or risk creating a global culture more conducive to the worst abuses.

The second is that this type of regulation, particularly if armed with enforcement mechanisms, will be used by opponents of legitimate research to advance principles antithetical to the genetic engineering process as a whole, including its many benefits. This is a real danger, although the supporters of the treaty will always be able to invoke the counter-pressure of needing to maintain a progressive and permissive framework in order to keep the most advanced countries on board.

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[5] Technology required to develop nuclear arms has become far more easily transferable, non-signatory states - North Korea, Pakistan- have transferred requisite knowledge and equipment, exceptions to the norms have been carved out for India, a non-signatory state.

Although the prospect of human genetic modification is terrifying to many, it is a reality, and a potentially beneficial reality, of our future. As difficult as it will be to establish an international framework for maximizing the benefits and minimizing the dangers of this revolutionary advance, the alternative of allowing these capabilities to emerge unregulated and unchecked will prove much tougher and less desirable in the long run. The science is moving extremely fast. The policy framework must now begin to catch up.